

Docket: CS 99 - 060C  
SN: 09/518,204



To: Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

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MAR 11 2004

From: George O. Saile, Reg. No. 19,572  
28 Davis Avenue  
Poughkeepsie, N.Y. 12603

Subject:

Serial No.: 09/518,204

Filed: 03/03/00

Inventor: Keung Ho

Title: Chemical Agent Additives in Copper CMP Slurry

Group Art Unit: 1746

Examiner: Carrillo, B. S.

Attorney Docket: CS 99 - 060

### APPEAL BRIEF

Dear Sir:

In response to the rejection of the claims in the above identified application for patent, made in the FINAL REJECTION in the office action, dated May 29, 2003, and the Advisory action dated August 7, 2003, Applicant filed a NOTICE OF APPEAL on August 28, 2003. Please accept our APPEAL BRIEF herewith together with the FEE of \$ 330. The commissioner is hereby authorized to charge payment of the above fee associated with this communication to Deposit account No. 19-0033. A duplicate copy of the request is enclosed. No oral hearing is requested.

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TC 1700

### CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450, on March 5, 2004.

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09518204 Signature/Date

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## APPEAL BRIEF

### 1. Real Party in Interest

The real party in interest is the assignee:

Chartered Semiconductor Manufacturing LTD.  
60 Woodlands Industrial Park D, Street 2  
Singapore, Singapore 38406

An assignment has been recorded for this patent Application.

### 2. Related Appeals and Interferences

There are no related Appeals or Interferences.

### 3. Status of Claims:

Claims 1 to 18 are finally rejected under 35 U.S.C. § 103(a). No claims have been allowed.

### 4. Status of Amendments

On July 24, 2003, Applicants filled a Response to the Final Rejection dated May 29, 2003. The Response sought to overcome the rejection of claims. In an Advisory Action dated August 7, 2003, the rejections were maintained. Claims 1 to 18 stand finally rejected.

### 5. Summary of the Invention

The invention provides a method to polish a metal layer having recessed portions using a slurry including a polishing agent containing: a chemical agent including at least a *carbonyl derivative* of benzotriazole, the chemical agent

forming a protective film on the surface of the metal layer; and an etching agent for etching the metal layer.

CLAIM 1 (AMENDED) IS READ ON THE SPECIFICATION AND DRAWINGS AS FOLLOWS:

1. (previously amended) A polishing method comprising the steps of:

a) (AS SEEN IN FIG. 4A; and SPECIFICATION PAGE 12, LINES 5 to 17) forming a layer made of material containing a metal as a main component over a substrate having recessed portions on a surface thereof so as to fill said recessed portions with said metal layer; and

b) (AS SEEN IN FIGS. 4B and 4C; and SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 18, LINES 8 to 13) polishing said metal layer by a chemical mechanical polishing method using a slurry including a polishing agent containing

i) (SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 17, LINE 14 to PAGE 18, LINE 4) a chemical agent being responsible for forming a protective film on the surface of said metal layer by reacting with said material containing a metal as a main component, wherein said chemical agent includes at least a carbonyl derivative of benzotriazole, and

ii) (SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 18, LINES 13 to 16) an etching agent being responsible for etching said material containing a metal as a main component.

CLAIM 8 (AMENDED) IS READ ON THE SPECIFICATION AND DRAWINGS AS FOLLOWS:

8. (previously amended) A polishing method comprising the steps of:

a) (AS SEEN IN FIG. 4A; and SPECIFICATION PAGE 12, LINES 5 to 17) forming a film made of material containing a metal as a main component over a substrate having recessed portions on a surface thereof so as to fill said recessed portions with said film; and

b) (AS SEEN IN FIGS. 4B and 4C; and SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 18, LINES 8 to 13) polishing said film by a chemical mechanical polishing method using a slurry including a polishing agent containing

i) (SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 17, LINE 14 to PAGE 18, LINE 4) a chemical agent being responsible for forming a protective film on the surface of said film by reacting with said material containing a metal as a main component, and

ii) (SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 18, LINES 13 to 16) an etching agent being responsible for etching said material containing a metal as a main component;

(AS SEEN IN FIG. 4C; and SPECIFICATION PAGE 19, LINES 3 to 12) thereby forming a conductive film in said recessed portions,

(SPECIFICATION PAGE 12, LINES 18 to 20) wherein said metal is Cu or a Cu alloy and said chemical agent includes at least a carbonyl derivative of benzotriazole.

CLAIM 14 (AMENDED) IS READ ON THE SPECIFICATION AND DRAWINGS AS FOLLOWS:

14. (previously amended) A polishing method comprising the steps of:

a) (AS SEEN IN FIG. 4A; and SPECIFICATION PAGE 12, LINES 5 to 17) forming a film made of material containing a metal as a main component over a substrate having recessed portions on a surface thereof so as to fill said recessed portions with said film; and

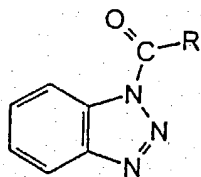
b) (AS SEEN IN FIGS. 4B and 4C; and SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 18, LINES 8 to 13) polishing said film by a chemical mechanical polishing method using a slurry including a polishing agent containing

i) (SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 17, LINE 14 to PAGE 18, LINE 4) a chemical agent being responsible for forming a protective film on the surface of said film by reacting with said material containing a metal as a main component, and

ii) (SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 18, LINES 13 to 16) an etching agent being responsible for etching said material containing a metal as a main component;

(AS SEEN IN FIG. 4C; and SPECIFICATION PAGE 19, LINES 3 to 12) thereby forming a conductive film in said recessed portions,

(AS SEEN IN FIGS. 2A AND 2C; and SPECIFICATION PAGE 12, LINES 18 to 20; and PAGE 13, LINE 3 to PAGE 15, LINE 1) wherein said metal is Cu or a Cu alloy and said chemical agent includes at least a carbonyl derivative of benzotriazole having the formula



where R is selected from the group consisting of - CH<sub>3</sub> (methyl), - CH<sub>2</sub>CH<sub>3</sub> (ethyl), - CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (propyl), - CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (n-butyl), - C(CH<sub>3</sub>)<sub>3</sub> (tert-butyl), p-tolyl, 1 – Benzotriazolyl – 1 – butamido, 2 – pyridyl, 3 – pyridyl, 4 – pyridyl, 2 – thiophenyl, and 3 – thiophenyl.

6. Issue:

I. Whether or not claims 1 to 18 are patentable under 35 U.S.C. § 103(a) over Sasaki et al. (U.S. Patent 5,770,095) (the '095 Sasaki Patent) in View of Ng et al. *Synthesis of Some Carbonyl Derivatives of BTA and Determination of Their Inhibitive Properties for Copper in 3% NaCl Solution*, Corrosion Science and Protection Technology, Vol. 9 (3), July 1997, pp. 201-204 (the Ng Article).

7. Grouping of Claims

The rejected claims have been grouped together in the rejection as shown above in the issue. The claims do not all stand or fall together. Appellants urge that in the claims 1 to 18 are separately patentable. These claims are separately patentable for the reasons set forth in more detail below.

8. ARGUMENT

I. Applicant asserts that claims 1 to 18 are patentable under 35 U.S.C. § 103(a) over Sasaki et al. (U.S. Patent 5,770,095) in View of Ng et al. *Synthesis of Some*

*Carbonyl Derivatives of BTA and Determination of Their Inhibitive Properties for Copper in 3% NaCl Solution, Corrosion Science and Protection Technology, Vol. 9 (3), July 1997, pp. 201-204*

Reconsideration of the rejection of claims 1 to 18 Under 35 U.S.C. § 103(a) as being unpatentable over Sasaki et al. (U.S. Patent 5,770,095) (the '095 Sasaki Patent) in View of Ng et al. *Synthesis of Some Carbonyl Derivatives of BTA and Determination of Their Inhibitive Properties for Copper in 3% NaCl Solution, Corrosion Science and Protection Technology, Vol. 9 (3), July 1997, pp. 201-204* (the Ng Article) is respectfully requested in view of the following remarks.

Applicants' wish to briefly point up the claimed *combination* of limitations of their invention which are believed to be not shown nor obvious from the teachings of known references in this field. The independent claims all clearly define polishing a metal layer having recessed portions using a slurry including a polishing agent containing: a chemical agent including at least a *carbonyl derivative* of benzotriazole, the chemical agent forming a protective film on the surface of the metal layer; and an etching agent for etching the metal layer.

The '095 Sasaki Patent describes a CMP metal polishing method using a slurry including a polishing agent containing: a chemical agent including "*benzotriazole ... (BTA), BTA derivatives including tryltriazole (TTA) which is prepared by substituting a hydrogen atom of a benzene ring of BTA with a methyl group,...*" that forms a protective film on the surface of the metal layer; and an etching agent of H<sub>2</sub>O<sub>2</sub>, HF and an amino acid for etching the metal layer. Sasaki, Col. 3, lines 38 to 44.

The instant Inventors specifically noted in the Detailed Description of the Preferred Embodiment:

While the 5,770,095 U.S. Patent to Sasaki et al. (hereinafter the Sasaki Patent) discloses using benzotriazole (C<sub>6</sub>H<sub>5</sub>N<sub>3</sub>) (BTA) (See Fig. 1A) or tryltriazole (C<sub>7</sub>H<sub>7</sub>N<sub>3</sub>) (TTA) (See Fig. 1B for its four variations), or a mixture of BTA and TTA, among others, as a chemical agent specific to

the material of the target film within a CMP polishing agent so as to form a protective film on the target film to suppress the isotropic chemical polishing, *the present inventors have discovered that when copper (Cu) is polished by CMP with BTA and/or TTA, the protection of Cu is still not enough that causes Cu dishing and non-uniform Cu surfaces. Use of BTA and/or TTA, for example in accordance with the Sasaki Patent, in a CMP method causes formation of Cu(I)BTA Cu surface complexes that is the protective film that suppresses the isotropic chemical polishing. (emphasis added)*

Page 10 of the instant Specification as filed.

The instant Inventors then disclose in the instant specification as filed:

The present inventors have discovered that by using carbonyl derivatives of benzotriazole as a chemical agent in a polishing agent within a CMP slurry instead of benzotriazole (or tryltriazole (TTA)), greater Cu protection capability is achieved over just BTA. *This is postulated to be primarily due to the increase of steric bulkiness and hydrophobicity of the substituted carbonyl group, thereby blocking oxidants from the Cu by the sterically bulky and / or hydrophobic carbonyl group of the BTA-carbonyl ligands. (See Fig. 5)* The flow chart of Fig. 3 should be referred to in conjunction with Figs. 4A - 4C that schematically illustrate the steps of the present invention's Cu CMP method. (emphasis added)

Page 11 of the instant Specification as filed.

Applicants respectfully submit that Sasaki's disclosure of using a chemical agent including "BTA derivatives including tryltriazole (TTA) which is prepared by substituting a hydrogen atom of a benzene ring of BTA with a methyl group" is not a sufficient teaching of using *any* BTA derivative, in fact such "BTA derivatives" so disclosed are limited to such derivatives such as TTA but not to, for example, carbonyl derivatives of BTA since the phrase "including tryltriazole (TTA) which is prepared by substituting a hydrogen atom of a benzene ring of BTA with a methyl group" limits "BTA derivatives."

The Ng Article describes the synthesis of seven (7) types of carbonyl derivatives of benzotriazole (BTA).



As noted above, the '095 Sasaki Patent does not disclose using a chemical agent including a carbonyl derivative of benzotriazole and while the Ng Article describes carbonyl derivatives of benzotriazole there is no teaching to combine these references. Sasaki specifically teaches using "BTA [benzotriazole], a BTA derivative such as a derivative prepared *by substituting a hydrogen atom of a BTA benzene ring with a methyl group*, and a mixture containing the aforementioned compounds are particularly effective when Cu or a Cu alloy is employed as the material containing a metal as a main component." Col. 3, lines 57 to 62.

Therefore independent claims 1, 8 and 14 distinguish over the '095 Sasaki Patent in view of the Ng Article under §103(a) for the above reasons and further, the prior art lack a suggestion that the reference should be modified in a manner required to meet the claims; the Examiner has not presented a convincing line of reasoning as to why the claimed subject matter as a whole, including its differences over the prior art, would have been obvious; the prior art references do not contain any suggestions (express or implied) that they be combined, or that they be combined in the manner suggested; and each reference is complete and functional in itself, so there would be no reason to use parts from or add or substitute parts to any reference.

Claims 2 to 7 depend from independent claim 1; claims 9 to 13 depend from independent claim 8; and claims 15 to 18 depend from independent claim 14; and are believed to distinguish over the combination for the reasons previously cited.

#### **The Claims do not stand or fall together**

Claims 1 to 18 do not stand or fall together. The claims are separately and individually patentable.

Claims 2 to 7 depend from Parent Claim 1; claims 9 to 13 depend from Parent Claim 8, and claims 15 to 18 depend from Parent Claim 14. Respective dependent Claims 2 to 7; 9 to 13; and 15 to 18 have non-obvious limitations that improve upon the invention's polishing method and are therefore separately patentable.

Specifically:

- a) the claim 2 limitation of wherein the carbonyl derivative of benzotriazole has the formula shown is a non-obvious limitation not shown or taught by Sasaki nor Ng in combination with the limitations of independent claim 1;
- b) the claims 3, 10 and 15 limitation of wherein the etching agent includes an oxidizer; an acid or base; and a buffering agent or organic amine is a non-obvious limitation not shown or taught by Sasaki nor Ng in combination with the limitations of respective independent claims 1, 8 and 14;
- c) the claims 4, 11 and 16 limitation of wherein the etching agent includes an oxidizer selected from the group consisting of  $\text{H}_2\text{O}_2$ ,  $\text{KIO}_3$ , and  $\text{Fe}^{3+}$ ; an acid or base of  $\text{HF}$  or  $(\text{CH}_3)_3\text{N}(\text{OH})$ ; and a buffering agent or organic amine selected from the group consisting of  $\text{NH}_4(\text{CH}_3\text{CO}_2)$ , alkanol amine, and amino acid is a non-obvious limitation not shown or taught by Sasaki nor Ng in combination with the limitations of respective independent claims 1, 8 and 14;
- d) the claims 5, 12 and 17 limitation of wherein the carbonyl derivative of benzotriazole comprises from about 0.0001 to 10 weight% of said polishing agent is a non-obvious limitation not shown or taught by Sasaki nor Ng in combination with the limitations of respective independent claims 1, 8 and 14; Applicants urge that this added limitation is not subject to determination by routine experimentation.
- e) the claims 6, 13 and 18 limitation of wherein the carbonyl derivative of benzotriazole comprises from about 0.01 to 5.00 weight% of said slurry is a non-obvious limitation not shown or taught by Sasaki nor Ng in

combination with the limitations of respective independent claims 1, 8 and 14; Applicants urge that this added limitation is not subject to determination by routine experimentation.

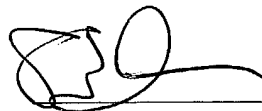
- f) the claim 7 limitation of wherein the metal is selected from the group consisting of Cu, a Cu alloy, Al, and an Al alloy is a non obvious limitation in combination with the limitations of independent claim 1; and
- g) the claim 9 limitation of wherein the carbonyl derivative of benzotriazole has the formula shown where R is selected from the group consisting of -CH<sub>3</sub> (methyl), -CH<sub>2</sub>CH<sub>3</sub> (ethyl), -CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (propyl), -CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (n-butyl), -C(CH<sub>3</sub>)<sub>3</sub> (tert-butyl), p-tolyl, 1 - Benzotriazolyl - 1 - butamido, 2 - pyridyl, 3 - pyridyl, 4 - pyridyl, 2 - thiophenyl, and 3 - thiophenyl is a non-obvious limitation not shown or taught by Sasaki nor Ng in combination with the limitations of independent claim 8.

Also, see above argument that explain in detail why the claims are non-obvious.

### CONCLUSION

Applicant requests that the Board of Appeals reverse the holding of the Examiner in finally rejecting the Claims 1 to 18 in the application. Allowance of all the claims is requested.

Respectfully Submitted,



Stephen B. Ackerman  
Reg. No. 37,761

Appendix  
COPY OF THE CLAIMS

1. (original) A polishing method comprising the steps of:

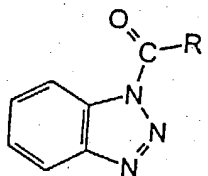
forming a layer made of material containing a metal as a main component over a substrate having recessed portions on a surface thereof so as to fill said recessed portions with said metal layer; and

5 polishing said metal layer by a chemical mechanical polishing method using a slurry including a polishing agent containing

a chemical agent being responsible for forming a protective film on the surface of said metal layer by reacting with said material containing a metal as a main component, wherein said chemical agent includes at  
10 least a carbonyl derivative of benzotriazole, and

an etching agent being responsible for etching said material containing a metal as a main component.

2. (original) The method of claim 1, wherein said carbonyl derivative of benzotriazole has the formula



where R is selected from the group consisting of - CH<sub>3</sub> (methyl), - CH<sub>2</sub>CH<sub>3</sub> (ethyl), - CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (propyl), - CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (n-butyl), - C(CH<sub>3</sub>)<sub>3</sub> (tert-butyl), p-tolyl, 1 – Benzotriazolyl – 1 – butamido, 2 – pyridyl, 3 – pyridyl, 4 – pyridyl, 2 – thiophenyl, and 3 – thiophenyl.

3. (original) The method of claim 1, wherein said etching agent includes an oxidizer; an acid or base; and a buffering agent or organic amine.

4. (previously amended) The method of claim 1, wherein said etching agent includes an oxidizer selected from the group consisting of H<sub>2</sub>O<sub>2</sub>, KIO<sub>3</sub>, and Fe<sup>3+</sup>; an acid or base of HF or (CH<sub>3</sub>)N(OH); and a buffering agent or organic amine selected from the group consisting of NH<sub>4</sub>(CH<sub>3</sub>CO<sub>2</sub>), alkanol amine, and amino acid.

5. (previously amended) The method of claim 1, wherein said carbonyl derivative of benzotriazole comprises from about 0.0001 to 10 weight% of said polishing agent.

6. (previously amended) The method of claim 1, wherein said carbonyl derivative of benzotriazole comprises from about 0.01 to 5.00 weight% of said slurry.

7. (previously amended) The method of claim 1, wherein said metal is selected from the group consisting of Cu, a Cu alloy, Al, and an Al alloy.

8. (previously amended) A polishing method comprising the steps of:

forming a film made of material containing a metal as a main component over a substrate having recessed portions on a surface thereof so as to fill said recessed portions with said film; and

5 polishing said film by a chemical mechanical polishing method using a slurry including a polishing agent containing

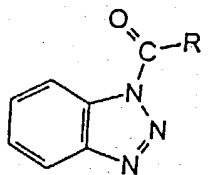
a chemical agent being responsible for forming a protective film on the surface of said film by reacting with said material containing a metal as a main component, and

10 an etching agent being responsible for etching said material containing a metal as a main component;

thereby forming a conductive film in said recessed portions,

wherein said metal is Cu or a Cu alloy and said chemical agent includes at least a carbonyl derivative of benzotriazole.

9. (original) The method of claim 8, wherein said carbonyl derivative of benzotriazole has the formula



where R is selected from the group consisting of - CH<sub>3</sub> (methyl), - CH<sub>2</sub>CH<sub>3</sub> (ethyl), - CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (propyl), - CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (n-butyl), - C(CH<sub>3</sub>)<sub>3</sub> (tert-butyl), p-

tolyl, 1 – Benzotriazolyl – 1 – butamido, 2 – pyridyl, 3 – pyridyl, 4 – pyridyl, 2 – thiophenyl, and 3 – thiophenyl.

10. (original) The method of claim 8, wherein said etching agent includes an oxidizer; an acid or base; and a buffering agent or organic amine.

11. (previously amended) The method of claim 8, wherein said etching agent includes an oxidizer selected from the group consisting of  $\text{H}_2\text{O}_2$ ,  $\text{KIO}_3$ , and  $\text{Fe}^{3+}$ ; an acid or base of HF or  $(\text{CH}_3)\text{N}(\text{OH})$ ; and a buffering agent or organic amine selected from the group consisting of  $\text{NH}_4(\text{CH}_3\text{CO}_2)$ , alkanol amine, and amino acid.

12. (previously amended) The method of claim 8, wherein said carbonyl derivative of benzotriazole comprises from about 0.0001 to 10 weight% of said slurry.

13. (previously amended) The method of claim 8, wherein said carbonyl derivative of benzotriazole comprises from about 0.01 to 5.00 weight% of said slurry.

14. (previously amended) A polishing method comprising the steps of:

forming a film made of material containing a metal as a main component over a substrate having recessed portions on a surface thereof so as to fill said recessed portions with said film; and

5 polishing said film by a chemical mechanical polishing method using a slurry including a polishing agent containing

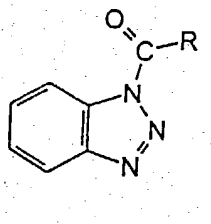
a chemical agent being responsible for forming a protective film on the surface of said film by reacting with said material containing a metal as a main component, and

10 an etching agent being responsible for etching said material containing a metal as a main component;

thereby forming a conductive film in said recessed portions,

wherein said metal is Cu or a Cu alloy and said chemical agent includes at least a carbonyl derivative of benzotriazole having the formula

15



20 where R is selected from the group consisting of - CH<sub>3</sub> (methyl), - CH<sub>2</sub>CH<sub>3</sub> (ethyl), - CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (propyl), - CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub> (n-butyl), - C(CH<sub>3</sub>)<sub>3</sub> (tert-butyl), p-tolyl, 1 - Benzotriazolyl - 1 - butamido, 2 - pyridyl, 3 - pyridyl, 4 - pyridyl, 2 - thiophenyl, and 3 - thiophenyl.

15. (original) The method of claim 14, wherein said etching agent includes an oxidizer; an acid or base; and a buffering agent or organic amine.

16. (previously amended) The method of claim 14, wherein said etching agent includes an oxidizer selected from the group consisting of H<sub>2</sub>O<sub>2</sub>, KIO<sub>3</sub>, and Fe<sup>3+</sup>; an



acid or base of HF or  $(\text{CH}_3)\text{N}(\text{OH})$ ; and a buffering agent or organic amine selected from the group consisting of  $\text{NH}_4(\text{CH}_3\text{CO}_2)$ , alkanol amine, and amino acid.

17. (previously amended) The method of claim 14, wherein said carbonyl derivative of benzotriazole comprises from about 0.0001 to 10 weight% of said slurry.

18. (previously amended) The method of claim 14, wherein said carbonyl derivative of benzotriazole comprises from about 0.01 to 5.00 weight% of said slurry.